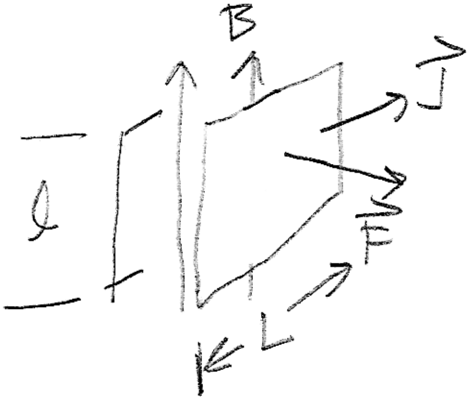


$$\vec{F} = q\frac{\vec{v}}{c} \times \vec{B}$$

$\frac{esu \cdot cm}{sec} \cdot \frac{1}{c}$ 0 outside
Full strength Inside

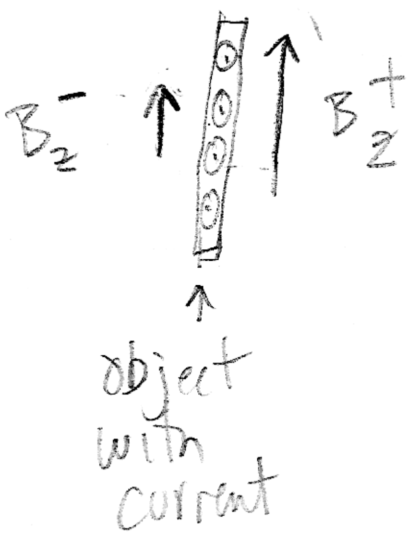
$$\underbrace{J \cdot t}_{} \cdot l \cdot L \cdot \frac{1}{c} \; \frac{1}{2} \cdot \frac{4\pi}{c} J$$

J, $\frac{esu}{sec\ cm}$ height cm length cm

$$\text{Pressure} = \frac{F}{l \cdot L} = \frac{c}{4\pi} B \cdot \frac{1}{c} \cdot \frac{1}{2} \cdot B$$

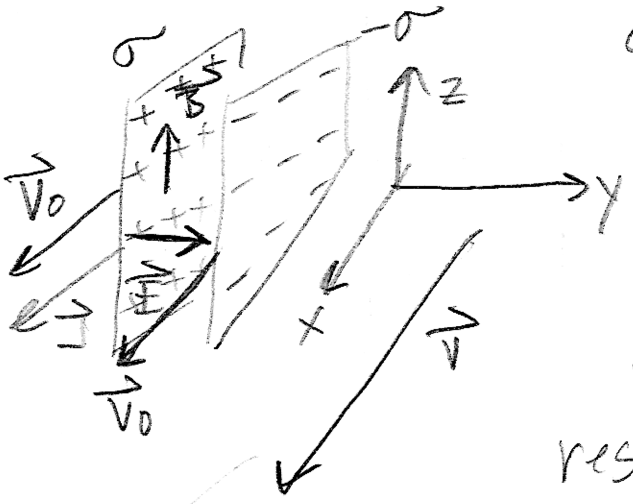
$$\boxed{\text{Pressure} = \frac{1}{8\pi} B^2}$$

more generally,



$$\text{Pressure} = \frac{1}{8\pi}\left((B_z^+)^2 - (B_z^-)^2\right)$$

away from high field region



charge density $\sigma \rightarrow$ in this frame.

$$\frac{\sigma}{\gamma_0} \qquad \gamma_0 = \frac{1}{\sqrt{1-\left(\frac{v_0}{c}\right)^2}}$$

in its rest frame.

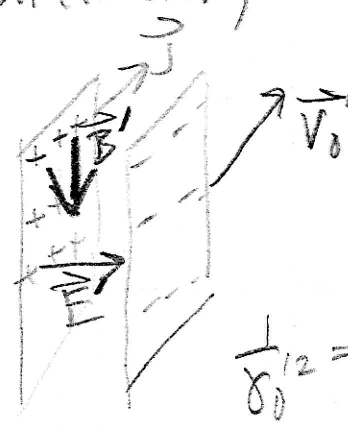
$$= \frac{1}{\sqrt{1-\beta^2}}$$

$$j = \sigma v_0 \rightarrow \frac{esu}{cm^2} \cdot \frac{cm}{s}$$

$$E_y = 4\pi\sigma$$

$$B_z = \frac{4\pi}{c} j = \frac{4\pi}{c}\sigma v_0 = 4\pi\sigma\beta_0$$

another frame, primed frame, zooms by with speed, $\vec{V} > \vec{v}_0$ the $\vec{E}', \vec{B}'$ are different, how do they relate?



$$v_0' = \frac{v_0 - V}{1 - \frac{1}{c^2}v_0 V} = c\,\frac{\beta_0 - \beta}{1-\beta_0\beta}$$

$$\frac{1}{\gamma_0'^2} = 1 - \left(\frac{v_0'}{c}\right)^2 = 1 - \frac{(\beta_0-\beta)^2}{(1-\beta_0\beta)^2}$$

$$= \frac{1 - \cancel{2\beta_0\beta} + \beta_0^2\beta^2 - \beta_0^2 + \cancel{2\beta_0\beta} - \beta^2}{(1-\beta_0\beta)^2}$$

$$\frac{1}{\gamma_0'^2} = \frac{(1-\beta_0^2)(1-\beta^2)}{(1-\beta_0\beta)^2} = \frac{1}{\gamma_0^2\gamma^2}\frac{1}{(1-\beta_0\beta)^2}$$

$$\gamma_0' = \gamma_0 \gamma (1 - \beta\beta_0)$$

$$\sigma' = \frac{\gamma_0'}{\gamma_0}\sigma = \gamma(1-\beta\beta_0)\sigma$$

$$j' = \sigma' v_0' = \sigma\gamma\cancel{(1-\beta\beta_0)} \cdot c \cdot \frac{\beta_0 - \beta}{\cancel{1-\beta_0\beta}}$$

$$j' = \sigma\gamma(v_0 - v)$$

$$E_y' = 4\pi\sigma' = 4\pi\gamma\sigma(1-\beta_0\beta)$$

$$= \gamma\left[4\pi\sigma - \left(\frac{4\pi\sigma v_0}{c}\right)\left(\frac{v}{c}\right)\right]$$

$$\boxed{E_y' = \gamma(E_y - \beta B_z)}$$

$$B_z' = \frac{4\pi}{c}\sigma' v_0' = \frac{4\pi}{c}\sigma\gamma(v_0 - v)$$

$$= \gamma\left[4\pi\sigma\frac{v_0}{c} - 4\pi\sigma\frac{v}{c}\right]$$

$$\boxed{B_z' = \gamma(B_z - \beta E_y)}$$

$\vec{v}$ in $\hat{x}$ direction: $\vec{v}\times\vec{B}$ in $-\hat{y}$

$\parallel \rightarrow$ parallel to $\vec{v}$, $\perp \rightarrow$ perp to $\vec{v}$ $\quad \vec{v}\times\vec{E}$ in $+\hat{z}$

$$\vec{E}_\perp' = \gamma(\vec{E}_\perp + \vec{\beta}\times\vec{B}_\perp) \qquad \vec{E}_\parallel' = \vec{E}_\parallel$$

$$\vec{B}_\perp' = \gamma(\vec{B}_\perp - \vec{\beta}\times\vec{E}_\perp) \qquad \vec{B}_\parallel' = \vec{B}_\parallel$$

Special Case ...

$$\vec{B} = 0$$

$$\vec{E}_{\parallel}' = \vec{E}_{\parallel} \quad \vec{E}_{\perp}' = \gamma \vec{E}_{\perp} \quad \vec{B}_{\parallel}' = 0$$

$$\vec{B}_{\perp}' = -\gamma \vec{\beta} \times \vec{E}_{\perp} = -\vec{\beta} \times \vec{E}_{\perp}'$$

but $\vec{\beta} \times \vec{E}_{\parallel}' = 0$ anyhow (they're parallel)

$$\vec{B}_{\perp}' = -\vec{\beta} \times \vec{E}'$$

$$\vec{E} = 0$$

$$\boxed{\vec{E}_{\perp}' = +\vec{\beta} \times \vec{B}'}$$